PATENT SPECIFICATION

Application Date: July 5, 1939. No. 19631/39. **530,912**

Complete Specification Left: July 5, 1940.

Complete Specification Accepted: Dec. 24, 1940.

PROVISIONAL SPECIFICATION

Improvements in or relating to Bearings for Scientific, Measuring, and other Precision Instruments, and to other Machine or Tool Parts from which Great Hardness and Wear-resistance is required

I, ARPAD NAGY, a citizen of Hungary, of 15, Evelyn Court, Stourcliffe Street, London, W.1, do hereby declare the nature of this invention to be as follows:—

The present invention relates to improvements in bearings of the kind serving for scientific instruments, as navigating compasses, scales, watches, measuring apparatus such as electric counters, gas meters (especially so called "odo-meters"), speedometers, and generally for all kinds of instruments where precision is required. The instruments of these kinds contain rotative or rocking orgams which are journalled in bearings which must minimize friction, and must resist wear as far as possible. The invention relates further to other machine or tool parts from which great hardness and wear resistance is required.

In order to provide bearings with these properties it has been heretofore the practice to use for the active part of a bearing a precious or semi-precious stone which has the required hardness and resists wear. Under the expression "precious stones" natural or synthetic minerals of a hardness above approximately 6.5 of the mohs hardness scale are meant, such as sapphires, rubies, agate, topaz, etc. Semi-precious stones are natural or synthetic stones of a hardness under approximately 6.5, such as calcedon, onyx, etc.

A bearing of this kind, so called "jewel bearing" has been manufactured in such a way, that a precious or semi-precious stone was shaped into a slightly conical form and set in a brass holder. The brass holder was in the form of a block, extending on one side into a tube or sleeve in which the stone was set with its base abutting the full inner surface of the sleeve block. Then the extending parts of the sleeve surrounding the stone were bent inwardly so as to clamp the stone on its conical surface. This method of manufacture necessitates, of course, a large number of operations which make the process complicated and the bearings expensive in manufacture.

Steel bearings are also known, the bearing parts of which are hardened. Bearings of this kind, however, having not the required properties as to hardness and resistance to wear, are not suitable for use in precision instruments. Moreover the hardening of the bearing parts involves a number of further operations besides making certain difficulties in carrying out in practice.

The present invention has for its object to remove all the drawbacks of the methods of manufacturing bearings for precision instruments of the kinds mentioned above and to provide a new bearing which has the required hardness, resistance to wear, and which may be manufactured in a very simple way, and which at the same time obviates the necessity of using a precious or semi-precious stone for the active part of the bearing. According to the invention a great reduction of manufacturing costs is achieved.

According to the main feature of the invention, the bearing consists of a single piece of material, known as "hard metal". Under the term "hard metals" materials are understood belonging to the tungsten, titanium, molybdenum, vanadium or tantalum carbide groups. These metals are in general sintered carbides of tungsten, titanium, molybdenum, vanadium or tantalum or alloys of two or more of these metals and contain a suitable binding agent such as cobalt. After sintering, they have a Brinel hardness of about 1800. For the purpose specified, a Brinel hardness not less than 1700 is required.

A further feature of the invention is to replace the precious or semi-precious stone with a naturally hard metal, which need not undergo heat treatment and in which the required bearing or other surface is pressed in soft state before sinter-

[*Price* 1/-]

ing, and then after sintering, if necessary, said bearing or other surface may be lapped.

In a modified way of carrying out the invention, a sintered carbide of one or more metals of the aforesaid group or an alloy of two or more of these metals is formed into the desired outer shape and heated to a temperature at which its binding agent, for instance cobalt, becomes soft. The temperature for cobalt is about 1430—1590° Fahrenheit (780—870° Centigrade). At this stage the required shape of the bearing or other surface is pressed by a negative diamond tool. After cooling, the bearing or other surface is lapped to the desired final precision, but in most cases the print of diamond in hard metal has a mirror-like surface and does not require any further treatment.

It is a considerable advantage of the invention, that the bearing or the like made in the way described, consists of a single piece of hard material, which does not require any subsequent hardening of the inner surfaces. As it is made all in one piece, no separate setting or cage is required and the bearing is very solid and rigid. The further advantage of the invention is that the bearing surface may be shaped in one operation.

Owing to the nearly everlasting and true form of the negative diamond tool, which does not undergo wear, a very great number of bearings or other surfaces can be produced with one tool, which makes the method according to the invention most suitable for mass production, reducing at the same time considerably the production costs.

In a further way of application, the invention may be used for pressing of shapes in hard metals, sintered or unsintered, by the use of a negative tool, for instance for drawing dies, moulds, and other shaped parts.

Dated this 5th day of July, 1939.
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Chartered Patent Agents,
Jessel Chambers,
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and Central House,
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Agents for the Applicant.

COMPLETE SPECIFICATION

Improvements in or relating to Bearings for Scientific, Measuring, and other Precision Instruments, and to other Machine or Tool Parts from which Great Hardness and Wear-resistance is required

I, ARPAD NAGY, a citizen of Hungary, of 18, Princess Court, Bryanston Place, London, W.1 (formerly of 15, Evelyn Court, Stourcliffe Street, London, W.1), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to improvements in bearings of the kind serving for scientific instruments, such as navigating compasses, scales, watches, measuring apparatus such as electric counters, gas meters, speedometers, and generally for all kinds of instruments where precision is required. The instruments of these kinds contain rotative or rocking organs which are journalled in bearings which must minimize friction, and must resist wear as far as possible. The invention relates further to other machine or tool parts from which great hardness and wear resistance is required, such for example as drawing and pressing dies.

In order to provide bearings with these properties it has hitherto been the practice to use as the bearing surface a suitably formed precious or semi-precious stone having the required hardness and resistance to wear. By the expression "precious stones" is meant natural or synthetic minerals of a hardness somewhat above 6.5 of the mohs hardness scale, such as sapphires, rubies, agate, topaz, etc. Semi-precious stones are natural or synthetic stones of a hardness somewhat under 6.5, such as calcedon, onyx, etc.

The usual method of manufacturing such bearings, which are usually known as jewel bearings, is to shape a precious or semi-precious stone into the required form and set it in a suitable holder in the form of a block formed at one end with a tube or sleeve of proper size for the reception of the stone The stone is placed in the sleeve and the upwardly extending sides of the sleeve surrounding the stone are then bent inwardly into binding engagement with the surface of the stone. The shaping of the stone to the proper form involves a large number

of operations which makes the process complicated and the bearings expensive to manufacture.

Steel bearings are also known but the bearing surface requires a special hardening treatment. Bearings of this kind, however, do not possess the required properties as regards hardness and resistance to wear and are not suitable for use in precision instruments. Moreover the hardening of the bearing parts involves a number of further operations besides presenting certain practical difficulties.

The present invention has for its object to remove all the drawbacks of the methods of manufacturing bearings for precision instruments of the kinds mentioned above and to provide a bearing which has the required natural hardness and resistance to wear, and which may be manufactured in a very simple way, and which at the same time obviates the necessity of using a precious or semi-precious stone as the bearing surface. Moreover the invention enables the manufacturing costs to be greatly reduced.

The invention employs for the formation of the bearing a block of hard metal formed with an accurately shaped cavity constituting the bearing surface. By the term "hard metal", as used herein and in the appended Claims, is to be understood any of the well known hard materials used commercially as cutting tools or dies, which have as their basis sintered or fused carbides of metals of the tungsten, titanium, molybdenum, vanadium and tantalum group or of boron, or mixtures of such carbides, associated with a suitable binding agent such as cobalt. After sintering, they have a Brinell hardness of about 1800.

According to the invention, a block of hard metal of the desired outer shape is heated to a temperature at which its binding agent, for instance cobalt, becomes soft. The temperature for cobalt is about 1300° C. At this stage the cavity which is to form the bearing surface is formed by pressing into the hard metal a tool having a diamond tip shaped to the form of the required cavity. The tool is maintained under pressure in the cavity while the hard metal cools, with the result that the imprint of the diamond in the hard metal has a mirror-like surface, owing to shrinkage of the hard metal during cooling into close contact with the diamond, and is available for use as a bearing surface without further treatment. The invention includes the application of the above-described method to the formation of accurately shaped cavities in hard metal bodies intended for other uses, for example as pressing or drawing dies.

It is a considerable advantage of the invention, that the bearing, die or the like made in the manner described, consists of a single piece of hard material, which does not require any subsequent hardening of the surfaces of the cavity. As it is made all in one piece, no separate setting or cage is required and the bearing is very solid and rigid. A further advantage of the invention is that the bearing surface is shaped in a single operation.

Owing to the nearly everlasting and true form of the diamond tool, which does not undergo wear, a very great number of bearings can be produced with one tool, which makes the method according to the invention most suitable for mass production, reducing at the same time considerably the production costs.

It has been proposed in Specification No. 245,654 to make a die for wire drawing or other purposes by introducing into a supporting steel matrix a supply of molten tungsten containing a hardening ingredient, such as carbon, in a quantity not exceeding 3%, and then pressing into the molten tungsten a water-cooled pointed tool which serves to cool and mould the tungsten body, it being stated that this results in the formation of a high percentage of carbides, especially at and near the chilled surface.

The invention will now be described in further detail, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a vertical section, on a greatly enlarged scale, through a jewel bearing of conventional construction,

Figure 2 is the corresponding plan view,

Figure 3 is a vertical section likewise on a greatly enlarged scale, illustrating the formation of a bearing by the method according to the invention, and

Figure 4 is a vertical section, similar to that in Figure 3, illustrating a shaped article, made by the method according to the invention, which is suitable for use both as a bearing and as a pressing die.

The jewel bearing of known design, shown in Figures 1 and 2, consists of a precious or semi-precious stone 10 of approximately 2 mm. in diameter which is shaped to the form of a truncated cone, formed at its upper end with a bearing surface 11 in the form of an inverted cone, and bevelled off as indicated at 15. The stone 10 is set in a brass holder 12 the upper portion 13 of which forms a tube for the reception of the stone. The portions 14 of the tube which surround the stone are then spun

inwardly so as to clamp the stone in the holder. It will be appreciated that difficult and wearisome operations are involved in forming the tiny stone to the required shape and enclosing it in the surrounding brass holder.

The method according to the invention of making a bearing is very much simpler and quicker. A block 16 of hard metal is cut from a cylindrical rod and heated, by a flame, electrically or in any other convenient manner, to a temperature at which its binding agent softens, i.e. about 1300° C. in the case of cobalt. The hard metal block 16 is then placed in a press, and a tool 17 having a tip 18 constituted by a diamond, is forced under pressure into the hard metal. The diamond tip 18 is shaped to the form of the cavity 19 which is to form the bearing surface and which in this case is conical. The diamond is maintained under pressure in the cavity until the hard metal has cooled, which is important as if the diamond is removed the hard metal will distort on cooling and the cavity will no longer accurately reproduce the form of the diamond and will require to be ground to shape before the hard metal block can be used as a bearing. The block produced as a result of the above-described series of operations can be used as a bearing without any further treatment and does not require the support of an external holder.

In Figure 4 is shown a block 16 of hard metal formed with a cavity 19 of hemishperical form. This is achieved by adopting the same method as that described with reference to Figure 3, except that a tool with a hemispherical diamond tip is used in place of one with a conical diamond tip. The hard metal block 16 shown in Figure 4 can be used as a bearing or as a pressing die, for example for forming heads on pins.

Where the invention is to be applied to the production of a drawing die a hole is first produced, by grinding, in the hard metal block by the method described in Specification No. 521,697, and the hole is then enlarged to form an accurately shaped drawing orifice, by the method described above, using a tool tipped with a diamond of suitable form.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A method of shaping a hard metal to form articles, such as bearings or dies, having an accurately shaped cavity, which consists in heating a block of the hard metal to a temperature at which its binding agent becomes soft, forming the cavity by pressing into the hard metal a tool having a diamond tip shaped to the form of the cavity, and maintaining the tool under pressure in the cavity while the hard metal cools.

2. A bearing, consisting of a block of hard metal having formed in it, by the method claimed in Claim 1, a cavity constituting the bearing surface.

3. A die for pressing or drawing metals consisting of a block of hard metal, having formed in it, by the method claimed in Claim 1, a cavity for pressing or drawing the metal.

Dated this 5th day of July, 1940.

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Patent Agents for the Applicant.

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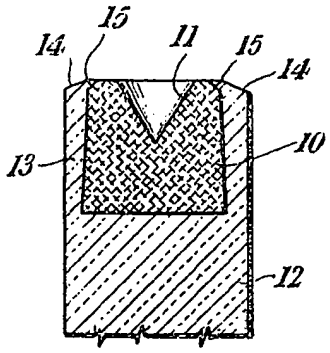

Fig. 1.

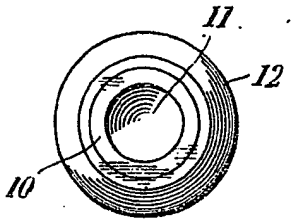

Fig. 2.

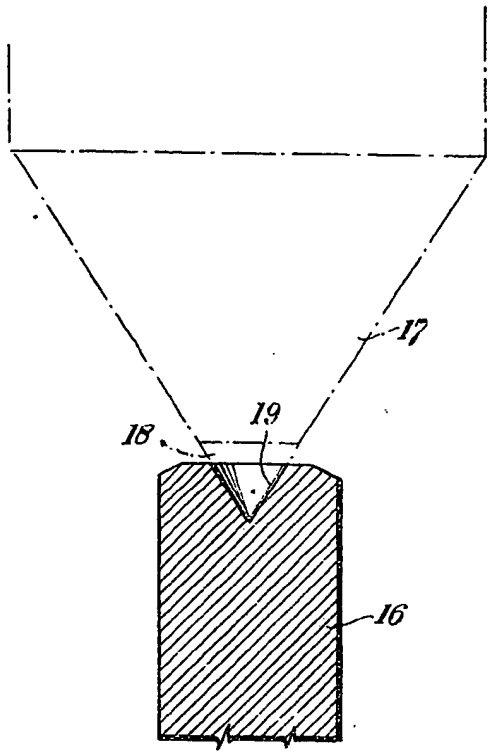

Fig. 3.

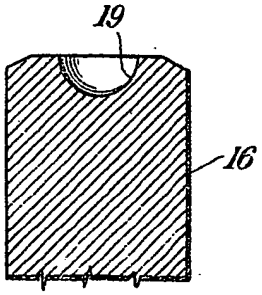

Fig. 4.

[This Drawing is a reproduction of the Original on a reduced scale.]

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